Signals and Circuits

ENGR 35500

Introduction to Communication Systems

Reference: James Flynn, Sharlene Katz, Introduction to communication systems

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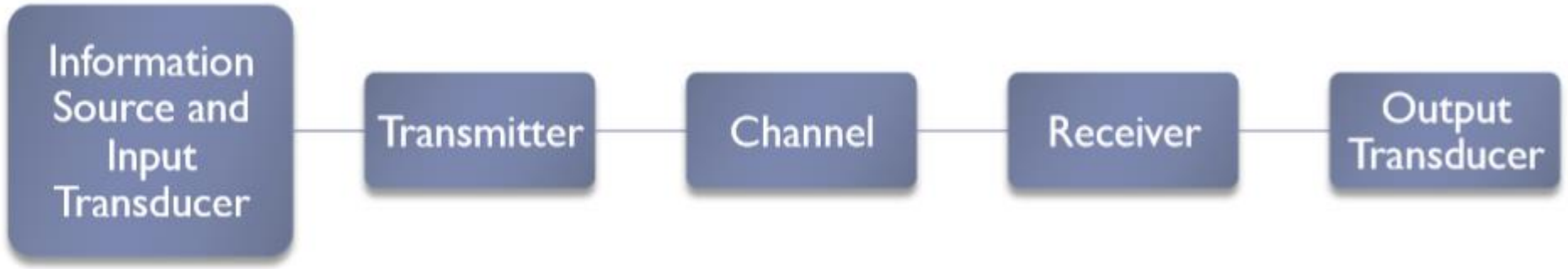
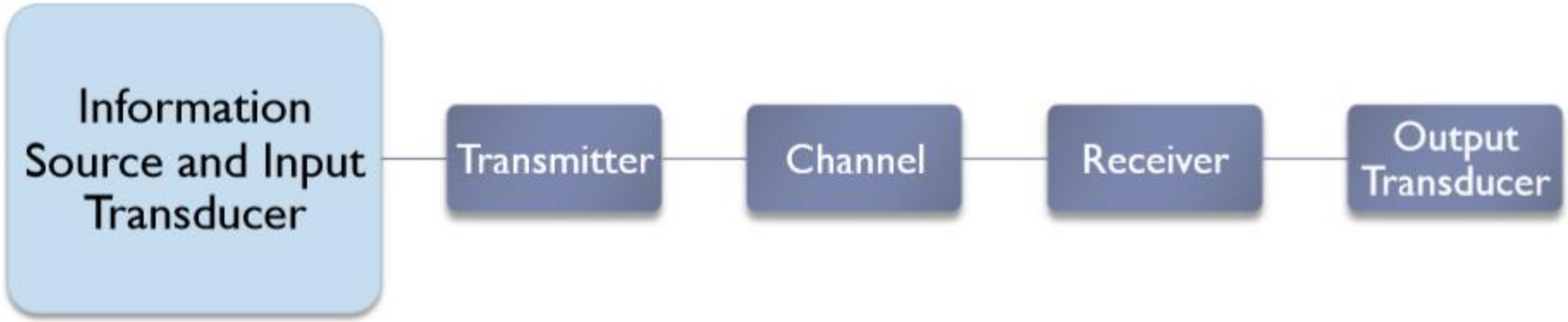
Communications System Diagram



Communications System Diagram

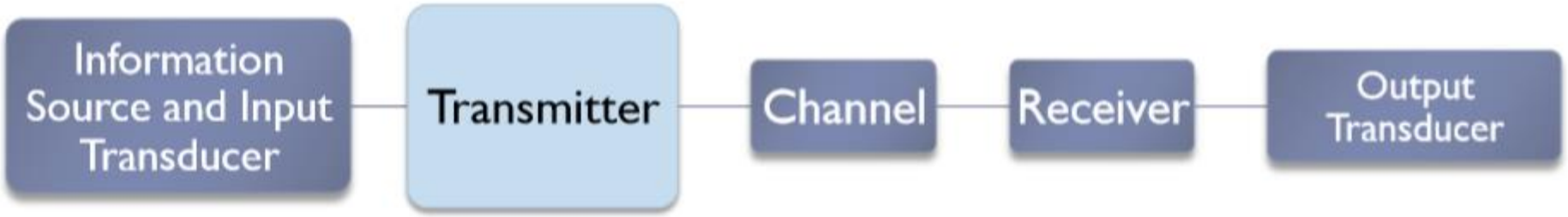


Information Source: Audio, image, text, data

Input Transducer: Converts source to electric signal

- Microphone
- Camera
- Keyboard

Communications System Diagram



Transmitter:

- Converts electrical signal into form suitable for channel
- Modulator
- Amplifier

Communications System Diagram

Channel: Medium used to transfer signal from transmitter to receiver. Point to point or Broadcast

- Wire lines
- Fiber optic cable
- Atmosphere
- Often adds noise / weakens & distorts signal

Communications System Diagram

Receiver

- Extracts an estimate of the original transducer output
- Demodulator
- Amplifier

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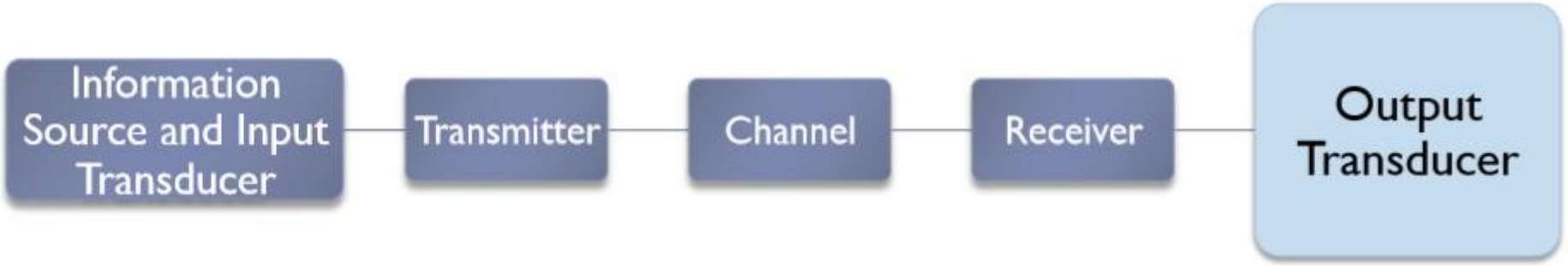
Communications System Diagram



Output Transducer: Converts electric signal to useable form

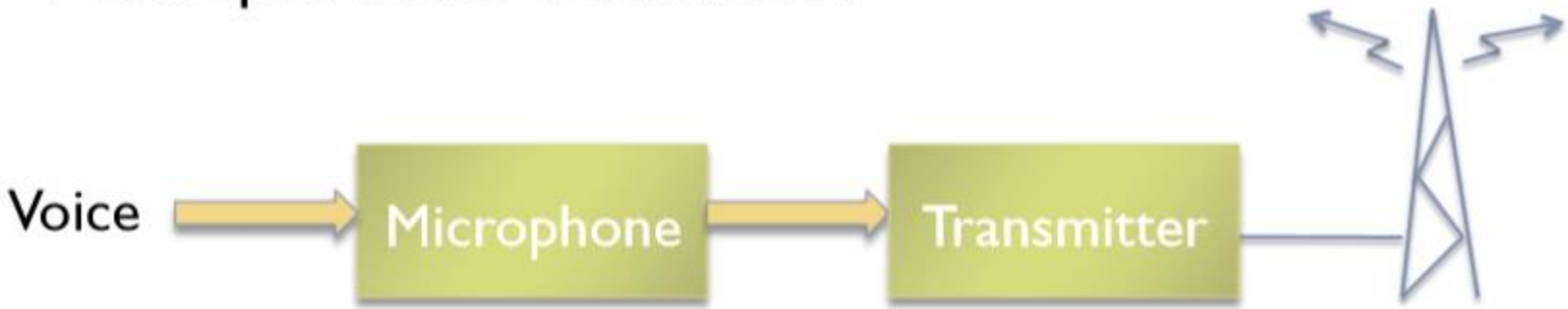
- Speaker
- Monitor

Why do we need modulation/demodulation

- Frequency Assignment
- Reduction of noise/interference
- Multiplexing
- Bandwidth limitations of equipment
- Frequency characteristics of antennas
- Atmospheric/cable properties

Why do we need modulation/demodulation

- Example: Radio transmission



Electric signal, 20 Hz – 20 KHz

Antenna: Size requirement > 1/10 wavelength

At 3 KHz: $\lambda = \frac{c}{f} = \frac{3\times10^8}{3\times10^3} = 10^5 = 100km$

$\Rightarrow .1\lambda = 10km$

Antenna too large! Use modulation to transfer information to a higher frequency

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Types of modulation

Analog modulation:
AM, FM etc.

Digital modulation:
FSK, PSK, QPSK etc.

Wireless

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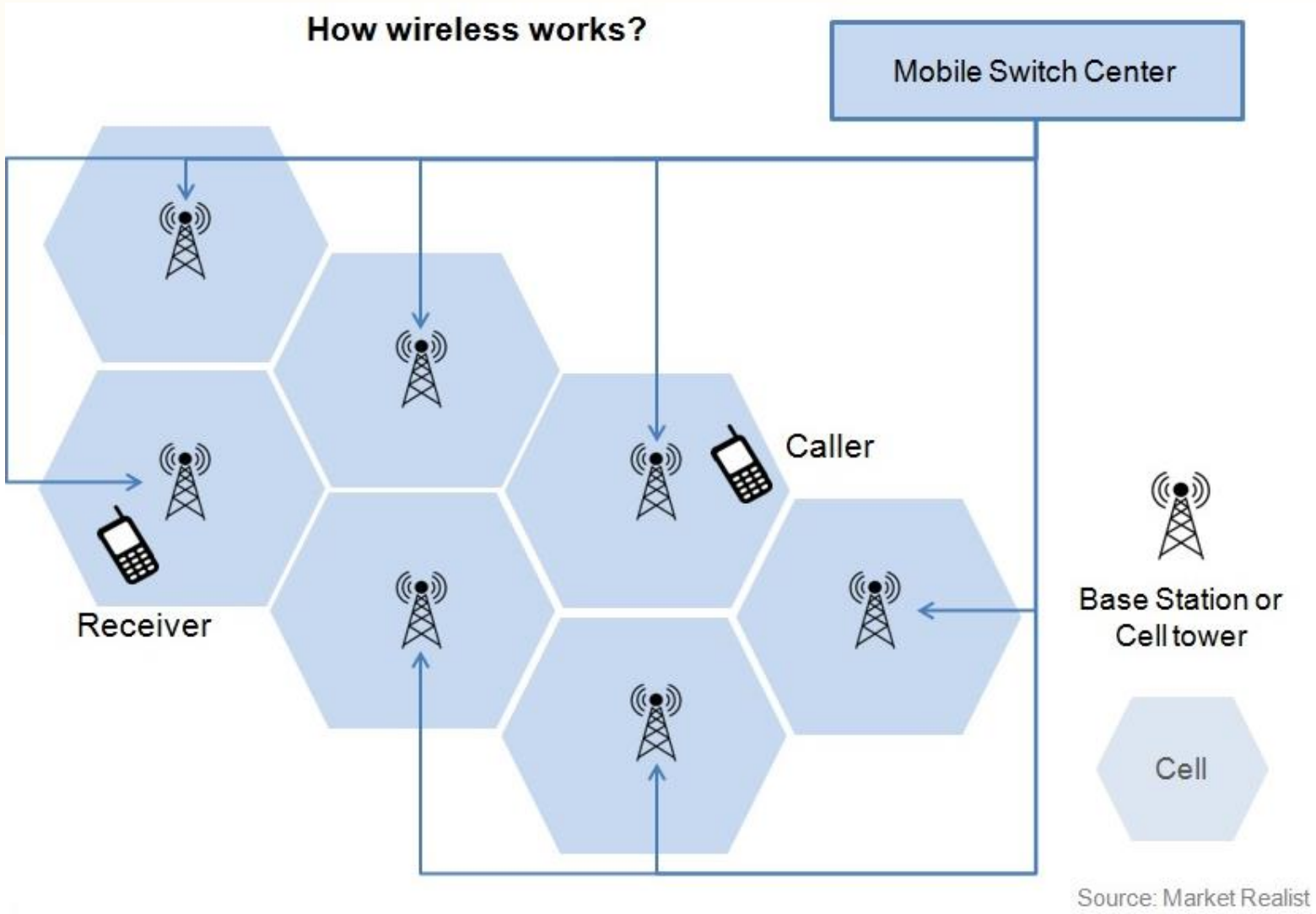
Wireless

- **Radio transmits at 10KHz to 1KHz**
- **Microwaves transmit at 1GHz to 500GHz （e.g. cellphone wave）**
- **Infrared transmits at 500GHz to 1THz**
- **Radio transmission may include:**
  - Narrow band
  - High-powered
  - Frequency hopping spread spectrum (the hop is controlled by accurate timing)
  - Direct-sequence-modulation spread spectrum (uses multiple frequencies at the same time, transmitting data in ‘chips’ at high speed)

Wireless



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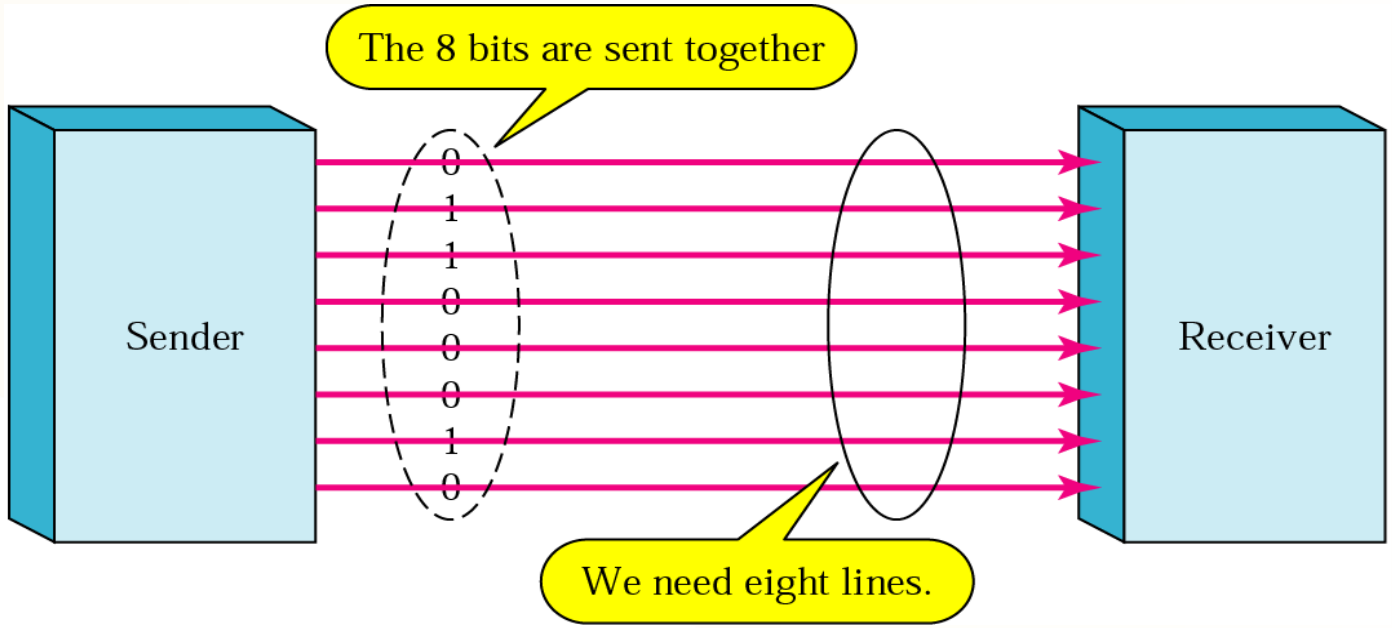
Data transmission

- Parallel
- Serial
  - Asynchronous
  - Synchronous

Data transmission

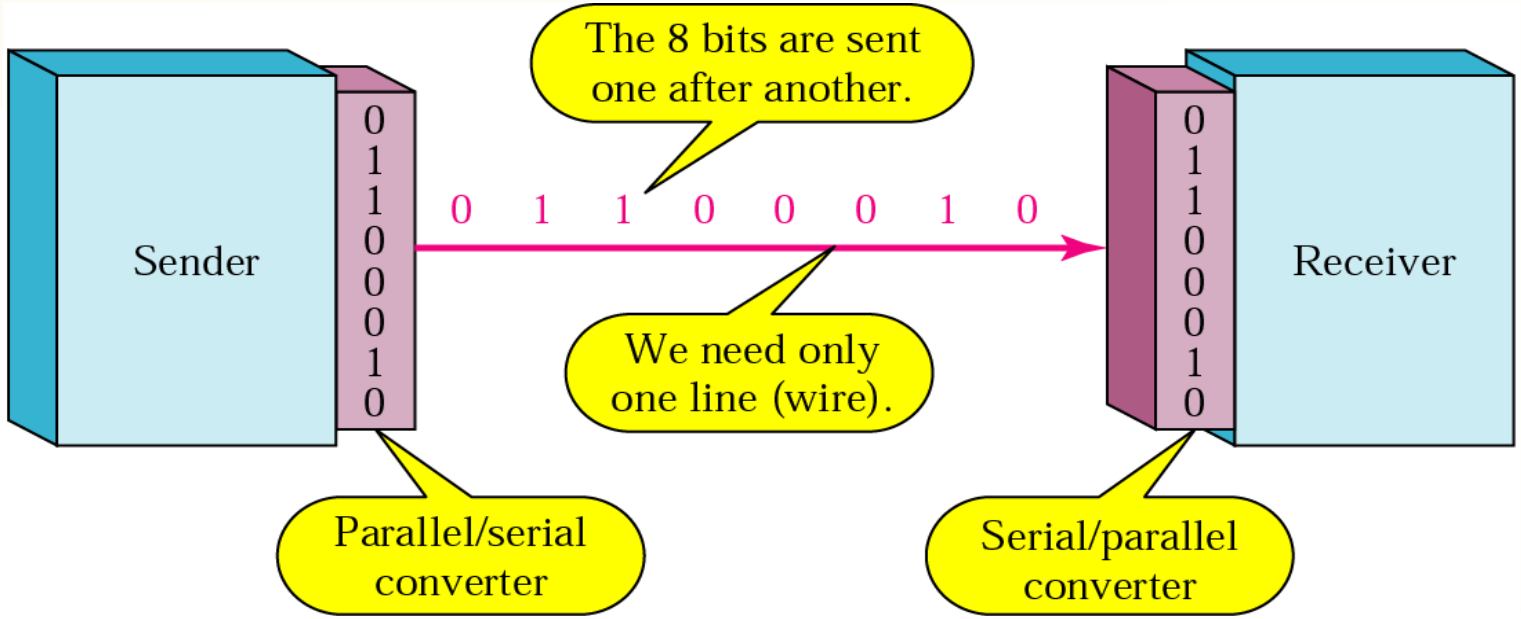
- **Parallel transmission**



- Advantage: speed
- Disadvantage: high cost (needs a wire for each bit)
- limited to short distances
- E.g. between some printers and PC

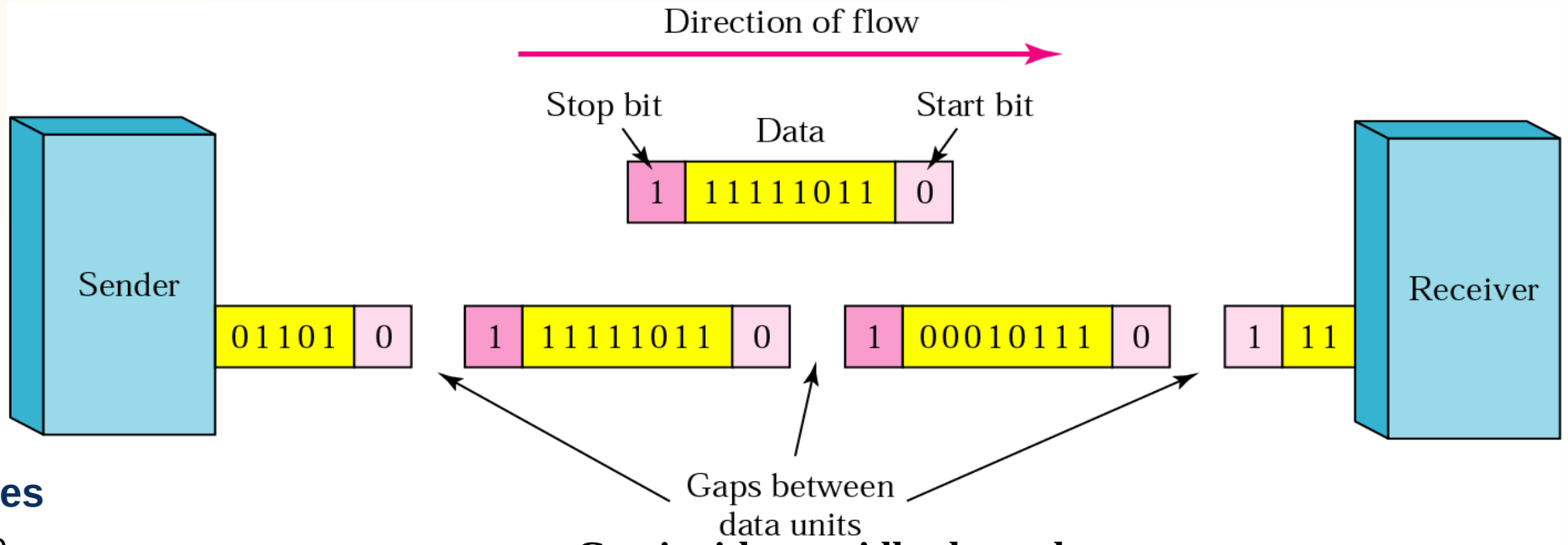
Data transmission

- **Serial transmission mode**



Data transmission

- **Serial transmission mode (Asynchronous transmission)**



Gap is either an idle channel or additional stop bits

➢ **Advantages**

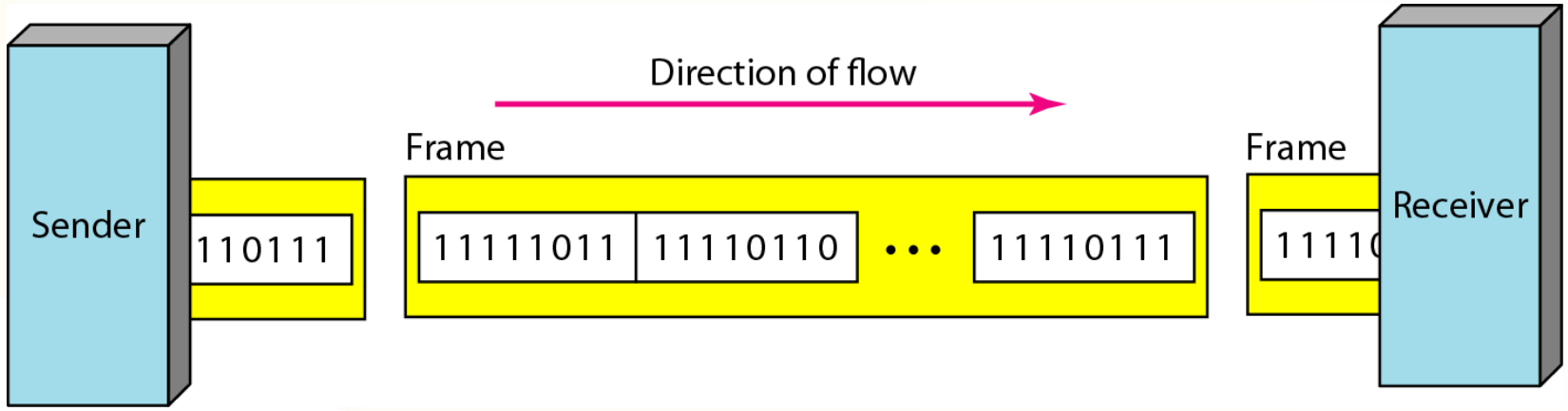
- Simple
- Cheap

➢ **Disadvantages**

- Not effective usage of channel bandwidth
  - Overhead **>=** 2/(8-bit ASCII code + 2) = 20%
- **Not suitable for long blocks** of data because the **receiver's clock** might ***drift out*** of synchronization with the transmitter's clock.
- Used with **slow transmissions** (one character at a time)

Data transmission

- **Serial transmission mode (Synchronous transmission)**



➢ **Advantages**

- more efficient than asynchronous

➢ **Disadvantages**

- Costly
- Operation complicatedly

➢ **E. g.**

- between computers, between modems, and routers

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